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METEOROLOGY.—*The unusual atmospheric haziness during the latter part of 1912.* H. H. KIMBALL, Weather Bureau.

In a previous paper[1] it has been shown that when first observed at Mount Weather on June 10, 1912, the haziness did not differ materially from that usually observed on the rear of anti-cyclonic areas, except in its unusual density. Subsequently,[2] after the haze had continued almost uninterruptedly for over two months, it was thought that dust from Katmai Volcano, in Alaska, had added its hazing effect to that of purely meteorological origin. A careful compliation of all available observational data relative to unusual haziness or smokiness or decreased atmospheric transparency, during the latter part of 1912, was at once undertaken. The results, of which the following is a summary, will be found in greater detail elsewhere.[3]

Observational data. The observations have been derived from the following sources:

1. Descriptive papers and notes in various scientific journals.
2. Extracts from the meteorological reports for June, 1912, of the coöperative observers of the U. S. Weather Bureau.
3. Replies to a circular letter dated December 7, 1912, addressed to officials in charge of Weather Bureau Stations, and requesting copies of all notes made in the Daily Local Record since June 1, 1912, relative to

[1] This Journal, **2**, 402, 1912.

[2] Bull. Mt. Weather Observatory, **5**, 161.

[3] The effect upon atmospheric transparency of the eruption of Katmai Volcano. Monthly Weather Review. January, 1913. The effect of the atmospheric turbidity of 1912 upon solar radiation intensities and skylight polarization. Bull. Mt. Weather Observatory 5, pt. 5.

the occurrence of any unusually hazy or smoky conditions of the atmosphere, or of unusually brilliant colors at sunrise or sunset.

4. Extracts from the meteorological reports of observers in British Columbia, which were kindly forwarded to the Chief of the U. S. Weather Bureau by the Director of the Meteorological Service of Canada.

5. Extracts from the logs of ships sailing on the North Pacific Ocean in June, 1912.

6. Replies to a circular letter dated December 28, 1912, addressed to members of the Astronomical and Astrophysical Society of America, and requesting copies of any observational data they might have relative to a possible diminution in atmospheric transparency after June 1, 1912.

7. Observations of skylight polarization made by me at Mount Weather, Virginia, and Santa Fe, New Mexico, and pyrheliometric measurements made under my supervision at Mount Weather, Virginia, Madison, Wisconsin, and Lincoln, Nebraska.

Fall of volcanic ash. Katmai Volcano which is in the Aleutian Range, Alaska, latitude 58°N., longitude 155°W., approximately, became violently eruptive on the afternoon of June 6, 1912, and continued in a state of great activity for about three days; it was more or less active until the end of October and perhaps until the end of the year. As a result of these eruptions volcanic ash fell between June 6 and June 10 over an area extending in latitude from Rampart, Alaska, latitude 65½°N to Loring, Alaska, latitude 55½°N and in the state of Washington to latitude 48½°N. In longitude the fall extended from Nushagak, Alaska, longitude 158½°W., to Chicken, Alaska, longitude 142°W., to Loring, Alaska, longitude 131° W., and in the state of Washington to longitude 122½° W. There also appears to have been a fall of very fine dust at Mount Wilson, California, on August 3–4, which discolored the silver film on the coelostat mirrors.

Haze and smoke. The observations show that a hazy or smoky period set in over British Columbia on June 6–8, and over the northwestern part of the United States on June 8–10. This continued until June 11–12, and in the meantime gradually extended eastward. A second hazy or smoky period set in over British Columbia on June 18–20, and over the northwestern part of the United States at about the same time. It extended gradually eastward and southward, and diminished in intensity before the end of the month, especially in the states west of the Rocky Mountains.

It appears that the haziness of these two periods is to be attributed to three different causes, namely:

1. The meteorological conditions, which are especially favorable for the formation of haze on the rear of anti-cyclonic areas. A well defined anti-cylonic area crossed the region east of the Rocky Mountains between June 6 and June 11. Another was central over the Rocky Mountain region between June 17 and June 21, and had passed eastward to the Atlantic ocean by June 24.

2. Smoke from forest fires. There were extensive forest fires in Yukon Territory, Canada, south of Dawson, during the latter part of May, 1912, and in British Columbia about June 6, and between June 11 and June 26. There were no important forest fires in the United States during the month of June.

3. Smoke or dust from Katmai Volcano.

While it is impossible completely to separate the effects of these three causes, it seems evident that the haze and smoke in British Columbia on June 9–10, which was generally accompanied by sulfur fumes, was at least in part of volcanic origin. The same may also be said of the smoke and haze that was particularly noticeable in the states of Washington, Montana, and Wyoming on the same dates, coming, as it did, at about the time of the fall of volcanic ash in the state of Washington. Several observers state that the haze of the latter part of June, as well as that of June 8–12, was a high haze, having some of the characteristics of cirrus clouds, but lacking their fibrous appearance. At Madison, Wisconsin, these cloud-like forms were first observed at 11 a.m. of June 8. If, as seems probable, they consisted of dust from Katmai Volcano, their rate of transportation had been about 73 miles per hour.

The haze appears to have been first observed in Europe between June 20 and 27, altho there is evidence that it was present previous to June 12. It was first observed in Algeria, Africa, on June 19, altho it is probable that it affected the bolometric determinations of solar radiation intensity as early as June 17. The characteristics of the haze, and its effects, appear to have been practically the same in Europe and in northern Africa as in North America.

Astronomical observations. While most of the replies to the circular letter addressed to members of the Astronomical and Astrophysica Society of America were to the effect that no data had been obtained bearing upon the question of a diminution in atmospheric transparency during the latter part of 1912, a considerable number furnished data that were confirmatory of such a diminution. For convenience of discussion these data were divided into four classes, as follows:

a. Visual observations of a general whiteness of the sky and a lack of transparency of the atmosphere.

b. Instrumental determinations of atmospheric transparency, which generally showed a decrease commencing with June or July.

c. Unsatisfactory results in astronomical photography, and a general increase in the exposure time required.

d. An observed increase in the brilliancy and duration of twilight colors.

These last were confirmatory of observations made by Weather Bureau observers, which indicated that twilight colors were unusually brilliant in October and November, altho at a few stations the colors were the subject of remark as early as June.

The decrease in atmospheric transparency as determined by observations classified under *b* and *c* was generally estimated at from 10 to 20 per cent.

A few observers detected a change in the color of sunlight as well as in that of sky light, apparently due to the excessive absorption or scattering of the shorter wave lengths.

Pyrheliometric observations. At Mount Weather, during the last half of 1912, the solar radiation intensities measured with the sun at zenith distance 60° averaged only 83 per cent of the corresponding intensities measured under normal conditions. At Madison, Wisconsin, they were 86 per cent of the average; while at Lincoln, Nebraska, in November, 1912, they averaged only 82 per cent of the intensities measured in November, 1911.

Sky light polarization. At the point of maximum polarization the percentage of polarized light averaged about 20 per cent less during the last half of 1912 than the average under normal conditions. Also, the solar and anti-solar distances of the neutral

points of Babinet and Arago, respectively, were materially increased when the sun was above the horizon. With the sun below the horizon the increase was slight, and in some cases there was even a decrease.

These effects upon sky light polarization are in every way similar to the effects observed in 1903 after the eruption of Mount Pelée in 1902.

The effect of decreased solar radiation intensities upon air temperatures. In the Bulletin of the Mount Weather Observatory **3**: 111, a diagram is given which shows that diminished solar radiation intensities comparable with those of 1912 occurred in 1884–86, 1891, and 1903. Each of these periods was accompanied and followed by temperatures below the normal in the United States. While the minus temperature departures were not greater than have occurred in other years, they persisted for a greater length of time.

It will be of interest to observe if the present depression in the solar radiation intensity curve is also followed by a long continued cold period in the United States.

PHYSICS.—*Recent theories of heat and radiation.*[1] W. WIEN, Professor of Physics, University of Würzburg.

In a series of lectures at Columbia University, I am treating several problems which are of peculiar interest to modern physics but which already present grave theoretical difficulties. The hypothesis of elements of energy or quanta, as given by Planck and expressed in the well known formula, is indispensable in the statistical treatment of molecular physics. It contains something, however, which lies beyond the commonly accepted system of physical theory. The difficulty in all these problems lies in the fact that one must constantly make use of relations, which are difficult to determine, between the theory of quanta and the older classical theory.

It is impossible as yet to say to what extent the theory of quanta may be applied. Thus far, its application has been confined to

[1] An address delivered before the Washington Academy of Sciences on April 23, 1913.

statistical considerations, and has been successful, but the assumption that the emission of radiation can only take place by quanta has not yet been necessary in any direct physical experiment. The success of the statistical treatment of the phenomena of heat, which has led to the theory of quanta, must be due to some peculiarity of the atom which has found its simplest expression in Planck's hypothesis of quanta, but it remains to be proved whether this assumption represents the true theory of the actual phenomena.

We can not say that the atom radiates energy only thru quanta, for if we accelerate an atom of canal radiation, it must send out energy according to the laws of the electromagnetic field. This energy can be calculated and may reach any arbitrary value. Nor is it possible to overcome this difficulty by assuming that the theory of quanta holds only for periodic variations, and an acceleration is not periodic—for in an alternating field we can impress such vibrations upon a charged atom that it will emit a radiation which is periodic but has nothing to do with the quantum. Again, if we regard heat as the elastic vibration of the atoms, it leads to the conclusion that the theory of quanta must apply there. On the other hand, acoustical vibrations of the same character have nothing to do with the quantum. To apply the theory of quanta to every possible kind of vibration seems, therefore, to lead to impossible consequences.

Once it seemed necessary to limit the application of the theory to the phenomena of irregular molecular motion, and, indeed, we may call Planck's formula the general expression of this irregular motion. From this point of view the theory of quanta tells us that such irregular molecular motion diminishes with temperature and disappears at absolute zero—which is synonymous with the assertion that entropy vanishes at zero as required by the Nernst theorem.

Since the theory of quanta gives us only a formula for the statistical treatment of the partition of energy, it is extremely difficult to find its true physical meaning. We might, of course, content ourselves with applying this statistical treatment to observed phenomena only, merely exchanging the theorem of equipartition

of energy for the general formula of the theory of quanta, but then our need for adequate causes remains unsatisfied, and, besides, we can not in this way avoid being forced to use the theory of quanta in connection with the classical theory of mechanics and electrodynamics. So long as these relations remain unknown, the theory will stand on uncertain ground. At the moment, the best way appears to be to apply the theory of quanta to as large a number as possible of the problems related to the theory of heat.

We may begin with the theory of radiation in the form given by Debye in connection with the theory of Rayleigh and Jeans. And this has the additional advantage of bringing out more clearly the true meaning of the theory of quanta, namely, that another partition of energy takes place, for the energy can only be divided in parts of magnitude $h\nu$.[1] This theory of quanta also lies at the foundation of the theory of specific heat, for the heat of solids is identified with the vibrations of the atom.

The assumption that energy can only be distributed in multiples of $h\nu$ corresponds with the first hypothesis of Planck, that emission and absorption can only take place in aliquot parts of magnitude $h\nu$. But it is well known that this theory is open to serious objections, for a discontinuous absorption of continuous radiation is hardly imaginable. Therefore Planck has now given up the assumption of quanta for the absorption and applies the hypothesis only to the phenomenon of emission, leaving the absorbed energy to reach any arbitrary value. The question then arises, How is it possible to bring this into harmony with the theory of specific heat?

According to Planck's new theory, each atom conceals a quantity of energy the mean value of which is $\frac{h\nu}{2}$ for each free vibration. This energy exceeds the heat energy, even at temperatures which are not very low. Is it therefore possible to assume two kinds of energy of vibrations, one that can not be transferred and another that we call the energy of heat? If elastic vibrations remain in the solid in such an amount that the heat energy is only a small

[1] Where ν is the number of vibrations and h a universal constant.

fraction of the total energy, how is it possible for the electric conductivity to depend in any considerable degree upon temperature?

The assumption that the energy can be distributed only in multiples of $h\nu$ can, it seems to me, be combined with Planck's new theory only on the hypothesis that the absorption of energy is continuous, but that the absorbed energy exists at first only in the form of energy of electrons. The vibrations of the atoms are identical with the heat energy, and disappear completely at absolute zero, but the energy of the electrons remains and amounts in the mean to $\frac{h\nu}{2}$. On this assumption, the theory of specific heat remains unchanged.

There is one further difficulty with vibrations of the infra-red rays which are assumed in the theory of dispersion to excite elastic vibrations of the molecules. These vibrations would also be heat vibrations, but there would remain an amount $\frac{h\nu}{2}$ not depending on temperature. Perhaps in this case also the motion of the electrons is primary. Then $\frac{h\nu}{2}$ would again represent the energy of the electrons.

The assumption that the electrons have a motion independent of temperature seems *not* to be a new hypothesis. It is founded on the theory of quanta, because the emission can only take place if the energy reaches $h\nu$. Now we know from Zeemann's phenomenon that the radiating particles are moving electrons, and therefore that the electrons must move before the radiation can begin. The theory of diamagnetism also requires the hypothesis of moving electrons independent of temperature. Debye's theory of specific heat is founded directly on the formula of partition of energy. It requires only the assumption that the heat energy is identical with the vibrations of the atoms, and that the forces are those which are assumed in the common theory of elasticity.

A serious difficulty arises in connection with the heat conductivity which should be determined by the elastic waves in the solid. The theory of elasticity is used for the determination of the number of free vibrations, and is thus connected with the

theory of quanta, but we do not yet know how to use this theory to calculate the velocity of molecular vibrations thru the solid.

In considering Planck's new theory, we assume an amount of energy $\frac{h\nu}{2}$ independent of temperature. To find the true law of radiation, one must adopt a definite law of emission, and so obtain a relation between the probability of emission and the rate of increase of energy to the critical value $h\nu$. It would be freer from objection to consider the law of radiation as determined by the considerations offered by Debye, and then to derive inversely the law of emission.

The now well-known theory of electrons was founded on the hypothesis that electric conductivity in metals is determined by free electrons moving in the metal with complete irregularity. In this form the theory can not hold, for H. A. Lorentz has shown that such free electrons must yield a radiation following the law of Rayleigh and Jeans. This radiation, especially for short waves, would be many times greater than is found by observation. The theory of specific heat also shows that only the molecules, not the electrons, possess heat energy.

One might perhaps hope to find a way out of the difficulty by assuming that the number of electrons is small in comparison with the number of atoms, but for low temperatures one would be forced to apply Planck's formula, not only to the atoms but to the electrons as well, and a new difficulty would at once result, since the free electrons can not have a vibration frequency equal to ν. If it were possible to identify the ν for an electron with the value for an atom, the electrons could no longer be regarded as free and there would be no difference between the free electrons and the electrons fixed in the atom. All the electrons would take part of the heat energy, and, their number being greater than the number of atoms, the value of the specific heat for high temperatures would be too high. There are many circumstances which make it probable that the energy of the electrons is independent of temperature. All emissions of electrons by radiation are independent of temperature, and the electrons coming from hot bodies can be emitted by radiation.

It is possible to develop a theory of electric conductivity if one considers the motion of electrons in metals to be independent of temperature. In this case the conductivity of metals could change only thru variation of the free path of the electrons. The free path of electrons will depend only upon the vibrations of the atoms, and must be inversely proportional to the numberof vibrating atoms. It would be more difficult to find the relation between the free path and the amplitude of the vibrations. A statistical consideration shows that the free path must be independent of the partition of the quanta only in case the free path be inversely proportional to the square of the amplitude. The vibrations are supposed to be identical with the elastic vibrations of the solid. In this way, one arrives at a formula for the conductivity, using the values obtained by the theory of elasticity, which agrees with the observations of Kammerlingh-Onnes except at very low temperatures. It also yields the high value for the temperature coefficient for iron and nickel. The derivation of the formula for electric conductivity suggests that the electrons are in irregular motion but the energy of this motion will not depend, as assumed in Drude's theory, on the temperature, for the motion considered remains unchanged even at the lowest temperatures. It is possible to identify this energy of the electrons with the energy $\frac{h\nu}{2}$ of the theory of radiation.

Some considerations have been offered by Einstein, which have considerable importance for the theory of quanta. They relate to fluctuations in the radiant energy caused by the irregularity of the emission. The theory of the Brownian movements founded on the theory of errors has shown such a surprising agreement with observation that it is necessary to take account of this theory in its application to radiation. Using Boltzmann's theorem of the relation between entropy and probability, this can be calculated from the known formula of the entropy of radiation. Applying the law of errors we can calculate the fluctuations of the radiant energy about its mean value. The calculation gives an expression which cannot be interpreted from the mean values for interfering rays, meeting in a point distant from the radiating

surface. The expression which represents the fluctuations contains two terms, one having the form which would result if the elements of energy were concentrated in points of space, the other expressing the fluctuations caused by interference alone.[3] But the second term of the formula also contains the constant h and one can combine the two terms into one, in consequence of which it is not quite certain whether the separation into two terms is due to the physical phenomena. Certain it is that at low temperatures the calculated fluctuations are larger than those caused by interference alone. Inasmuch as this case applies only to radiation which exists free in space it has no relation to observation.

Another case, which was also treated by Einstein, is therefore of great interest here. It concerns the irregular motion of a mirror accelerated by pressure of radiation in free space. In the calculation of this pressure the effect of small velocities vanishes because the pressure is the same on the front and on the back of the mirror. It is therefore necessary to calculate the second term which is proportional to the velocity. The expression for the mean energy of the irregular motion of the mirror is also made up of two terms and is quite analogous to the expression for radiant energy.

If the mirror be suspended in a space filled with radiation from a black body an energy equilibrium is established and it may be expected that the irregularities in the pressure of radiation will reach the magnitude given by the law of equipartition of energy. Therefore the mean energy of the mirror moving in one direction would be $\frac{1}{2}kT$.[4] But if we calculate the irregular motions caused by interference alone we shall find them smaller, the mean energy being proportional to kT and independent of h. It is unlikely that the mean energy of the real motions would be different from the value $\frac{kT}{2}$, for the irregularities caused by the pressure of radiation must be in equilibrium with the irregularities caused by other thermal phenomena. It seems therefore neces-

[3] From this expression Einstein was led to suggest the assumption that quanta also exist in space.

[4] Where k is the constant of the theory of gases and T the absolute temperature. This quantity of energy is equal to the mean energy of a gas-molecule.

sary to suggest a proper cause for increasing the irregular motions by the amount of the pressure. For the calculation of these irregularities it is altogether probable that the mirror cannot be considered to be a continuous body and the molecular structure of the mirror must be taken into consideration.

The theory of the Röntgen rays, is also connected in some way with the theory of quanta but is founded on purely electromagnetic considerations. Sometime ago I tried to calculate the wave length of the Röntgen rays from the theory of Stokes and Wiechert using only the measurements of energy. The electromagnetic theory gives the energy radiated by the retardation of an electron in a path of definite length. The radiated energy increases with the velocity of the electron and diminishes with the length of the path of retardation. The electron on the other hand radiates only in this path and the wave of electromagnetic disturbance is therefore enclosed between two spheres the centers of which lie at the extremities of the path. Hence the wave length can be calculated from the length of the path, that is, from the velocity and the radiated energy. The energy of the electrons can be calculated from the energy of the excited Röntgenrays. One can therefore calculate the wave length of Röntgen rays from the ratio of the energies of electrons and Röntgen rays. The value found in this way is considerably smaller than that found by observations of diffraction. Another way of calculating the wave length of Röntgen rays is given by the theory of quanta. If secondary electrons are excited by Röntgen rays the velocity acquired is much greater than can be explained by the electromagnetic theory. Only a few atoms, however, radiate secondary electrons.

For the simplest explanation of this observation the hypothesis is made that the energy of secondary electrons is derived from the energy accumulated in the atom and having the mean value $\frac{h\nu}{2}$. At first those atoms will radiate which possess a quantity of energy not very different from $h\nu$, and which need only to absorb a small amount of the incident radiation to reach the critical value $h\nu$. These atoms will then radiate and the energy of the emerging

electron is $\frac{m}{2} v^2 = h\nu$. The energy of the secondary electrons being known one can calculate the value of v and obtain a wave length for the Röntgen rays of the same order of magnitude as that which results from experiments in diffraction. It also seems probable that the Röntgen rays affect only the electrons and that the whole absorption is therefore caused by collisions of the secondary electrons with the atoms. In the production of Röntgen rays almost the whole energy of the cathode rays is transformed into heat. Sommerfeld has given a formula uniting the theory of Röntgen rays with the theory of quanta. He puts the action integral (principle of least action) equal to the constant $\frac{h}{2\pi}$, the integration being taken over the time of the molecular action. It is then possible to calculate from the values of the kinetic and potential energies and the constant h, the time of molecular action which corresponds to the time of radiation. According to this reasoning the value of the wave lengths resulting from the electromagnetic theory should agree with the value derived from the theory of quanta. In fact much smaller values for the wave lengths result from the electromagnetic theory. Sommerfeld explains this by assuming that the Röntgen rays are not monochromatic but consist of two kinds of radiation, one depending on the nature of the anticathode while the other is the radiation of the retarded electrons. The latter must be polarized in a plane such that the electric vibrations are parallel to the direction of retardation. One can then calculate the radiation of the retarded electrons from the polarized portion of the Röntgen rays. Using the observations upon the polarization of Röntgen rays one now finds an agreement.

Sommerfeld applies his theorem also to the electrons expelled by ultraviolet light by supposing that the energy acquired by the electrons is accumulated by resonance, but with this supposition I cannot agree. In this case a very long time must elapse before emission begins. For the explanation of the emission of electrons by light it seems to me rather that we must take account of the energy concealed in the atom.

One of the phenomena, in which the emission of light undoubtedly takes place thru the collision of molecules and atoms, is the positive rays. There we have atoms and molecules moving with high velocities which can be measured by means of magnetic and electric deflection or by direct methods. One can calculate the mean energy emitted by one atom in one spectral line from the ratio of the emitted intensity in the Doppler line to the number of atoms, which number can be found by observation of the current of positive electricity. On the other hand we find that the particles which are active in the positive rays do not retain their charge but lose it thru collisions with atoms at rest, and after being without charge for a time, they get a new one thru a second collision with a particle at rest. We have therefore always two kinds of particles, one charged and the other uncharged,—neglecting the negatively charged particles, whose number is comparatively small. In the state of equilibrium the number of particles in unit volume losing their charge, is equal to the number receiving a new charge, so that the number of charged as well as of uncharged particles remains constant. But the ratio of the number of charged particles to the number of those uncharged depends upon the number of collisions of both kinds of particles, and is equal to the ratio of the free path of charged particles to the free path of those uncharged. This ratio may be determined by taking away the charged particles in an electric field.

The free path itself can be found if the charged particles are deflected and the distance measured, thru which the uncharged particles must pass before a definite number receive their positive charges. It is found that the free path of the uncharged particles is greater than that of the charged particles but that the ratio of the one to the other depends on the pressure of the gas at rest. This is not in accord with the fundamental concept of the kinetic theory of gases, which demands that the free path be inversely proportional to the pressure. Also the absolute value of the free paths is not inversely proportional to the pressure but at low pressures diminishes more slowly than the pressure increases. These results show that the atoms cannot be regarded as entirely independent of each other. One may also observe that the absorption

of positive rays is not proportional to the pressure but is very much slower. Thus we see that even under these simple conditions the behavior of the atoms is very complicated.

Now it is certain that the emission of light takes place thru collisions of the moving atoms with atoms or molecules at rest and the question is whether or not the collisions effecting the emission of light are the same as the collisions which cause the atoms to lose or receive their charges. If we assume that the two kinds of collisions are the same, we must perforce apply the theory of quanta, because one atom cannot send out less radiation than one quantum. From the free path we know the number of collisions per *cm* of path, and, having found the mean energy emitted by one atom, we may calculate how many collisions are necessary to effect the emission of one quantum of a spectral line, that is, how many collisions must occur for each one which excites one quantum emission. But the emission of light by the positive rays depends very greatly on the velocity of the particles. If the velocity is very small no emission at all can come from the particles. The emission increases rapidly with the velocity but after reaching a maximum value it decreases so that for great velocities it again disappears. The emission of light is therefore associated with a small range of velocities.

In the light emitted by the positive rays we always have two spectral lines, one coming from the molecules at rest and the other from the moving molecules. One might think it possible to find a relation between those two by applying the principle of relativity. If we make the whole system move with the velocity of the moving atoms and in the opposite direction, then the atoms at rest become moving atoms, the moving atoms are now at rest and nothing is changed. One might therefore conclude that the light emitted by the moving atoms differs from the light coming from the atoms at rest only by the amount of the change demanded by Doppler's principle. But we have here a complication in that not only atoms or molecules but also electrons are emitted by atoms in collision and these secondary electrons likewise cause an emission of light if they are absorbed.

All these considerations show that the emission of light by the

positive rays is also a complex phenomenon, in which the emission of a spectral line depends not only on the radiating atom but also on the velocity of the atom or electron which excites the radiation. One must therefore try to make the conditions of experiment still simpler.

Another phenomenon to which it may be possible to apply the theory of quanta is the scintillation caused by the impact of α-rays against a phosphorescent body. In a sense we have here an elementary operation because the light, which is emitted in one scintillation is caused by a single α-particle. But the amount of energy radiated in the scintillation is much larger than one quantum and it seems that this energy does not come from a single atom of the phosphorescent substance but from a great number of atoms, all excited by the same α-particle.

After this survey of the field we are thus compelled to admit that for the moment we have no experiment which permits the observation of a single quantum of energy. With light we cannot hope to make such observations directly because more than thirty quanta are necessary to be perceptible to the eye. In Röntgen rays the element of energy is more than 1000 times larger but here we have no instrument of observation as sensitive as the human eye.

It is therefore unavoidable that in the study of the quanta theory we are confined to statistical methods, and these do not give us a convincing interpretation in terms of physical fact. It is only by applying the theory of quanta to many and widely different phenomena that we can hope to find out the true physical explanation of this novel theory. On the other hand it is evident that hardly more than the first steps have yet been taken and that by far the greater part of the work still remains to be done.

RADIOTELEGRAPHY.—*A Comparison of arc and spark sending apparatus for radiotelegraphy.* L. W. AUSTIN, U. S. Naval Radiotelegraphic Laboratory.

It has been claimed by the users of continuous oscillations in radiotelegraphy that these waves are less absorbed in passing

over the surface of the earth than the damped wave trains produced by spark sending. Several attempts have been made to settle this question by experiment, but over the moderate distances employed no difference in absorption has been observed. In order to extend these experiments to greater distances, a 30-kw. arc operated with 500-volt direct current was installed at the high power station at Arlington, Virginia. At a wave length of 4100 meters, the arc gave an antenna current of from 47 to 53 amperes. Comparisons were made of the received current from this arc and from the 500 cycle spark set giving from 100 to 120 amperes in the antenna. A very careful set of observations of the received currents from the two types of apparatus was made at St. Augustine, Florida, the measurements being taken by the calibrated detector and galvanometer method. The distance between the two stations was 530 nautical miles. The received currents were found to be simply proportional to the radiation currents at Arlington with an error not greater than 10 per cent; that is, at this distance there was no evidence of a difference in the absorption. These results were verified by the shunted telephone method using the slipping contact detector,[1] at New Orleans and also at Key West, both places being approximately 900 miles from Washington.

The receiving apparatus was then placed on the *U.S.S. Arkansas* and taken to Colon, 1800 nautical miles from Arlington. During the two days available for observation at Colon the receiving apparatus was taken to the Naval Radiotelegraphic Station. During these two days, the arc signals were heard at each schedule both day and night, while the spark signals were heard only at night. These observations indicated that at 1800 miles the continuous waves show a smaller degree of absorption than the damped waves. It was not possible, however, to draw this conclusion with certainty, since at the season of the year in which the observations were taken, late December, exceptional days occur which might perhaps affect the continuous oscillations in a different manner from those of the spark.

[1] Journ. Wash. Acad. 1: 8. 1911.

An additional series of observations has been made during the recent voyage of the *Salem* to Gibraltar and return. Here it was found, in verification of the Colon experiments, that for distances over 1400 miles the arc as received in the day time was equal to or somewhat better than the spark, notwithstanding the fact that the spark radiation current at Arlington was considerably more than twice as great as the corresponding arc current. Messages were continuously received with both arc and spark in the day time up to 2100 miles. Several times day signals were heard at greater distances, the arc being uniformly louder. The night signals were heard all the way to Gibraltar.

MINERALOGY.—*Triplite from eastern Nevada.* FRANK L. HESS and W. F. HUNT.[1] Communicated by F. L. Ransome.

Triplite, a manganese fluophosphate of pale salmon color, was found in specimens of tungsten ore sent by G. G. Sims from the Reagan district in the Kern Range, White Pine County, Nevada, to the United States Geological Survey. It occurs with wolframite (hübnerite?), scheelite, pyrite, chalcopyrite, an argentiferous sulfide of bismuth and lead, which is possibly cosalite, native bismuth, and a little sericite. The triplite is in irregular masses, the largest of which is less than an inch in diameter.

The mineral association strongly suggests pegmatitic origin and from its occurrence in other places the presence of triplite in a vein would appear to indicate that the vein is either an end product of differentiation in a pegmatite magma or was deposited by magmatic waters.

An analysis (by W. F. H.) gave only 1.68 per cent of FeO. Previously published analyses of triplite from other localities have shown from 7.69 to 41.42 per cent FeO, and the minerals have been of much darker color. The formula for the Reagan mineral approximates $MnO.P_2O_5.MnF_2$.

A more extended description will be later submitted for publication in the *American Journal of Science.*

[1] Published by permission of the Director of the United States Geological Survey.

HELMINTHOLOGY.—*Notes on Mononchus and Tylenchulus.* N. A. COBB. Bureau of Plant Industry.

Mononchus. Various observers have suggested that species of the genus *Mononchus* may be injurious to vegetation. For some years the writer has accumulated observations showing the species of this genus to be carnivorous. On various occasions the intestine has been seen to contain other nematodes that have been swallowed whole. On one occasion a *Mononchus* was captured in the act of swallowing another nematode. When *Mononchi* are placed in water with other species of nematodes the latter are sometimes seen suddenly to exhibit active motion, apparently

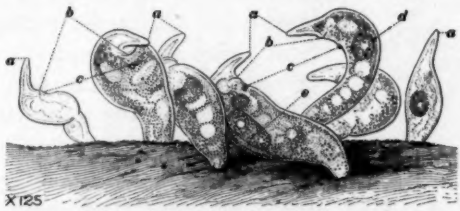

Fig. 1. Seven females of *Tylenchulus semi-penetrans* in various stages, as found on a feeding root of orange tree. The two outside specimens are younger than the others, which are adult or nearly so. A considerable portion of the head end of the worm is inside the root. The roots are injured. *a*, tail end; *b*, vulva; *c*, excretory pore; *d*, immature egg; *e*, ripe egg.

expressive of fear, when touched by the head of one of the *Mononchi*—acting, in fact, as if suddenly nipped or bitten. It would appear that *Mononchi* are beneficial to vegetation, rather than injurious, as the nematodes they feed upon are often injurious species.

Tylenchulus (New genus). Mr. E. E. Thomas has recently announced in Circular No. 85 of the California College of Agriculture a very interesting discovery in connection with the roots of citrus trees. Mr. J. R. Hodges, California State Horticultural Inspector, observed nematodes from the roots of orange trees, and concluded they were injurious. Thomas' investigations showed the nematodes to be of common occurrence, but he nevertheless concluded that the species was one not hitherto found on citrus

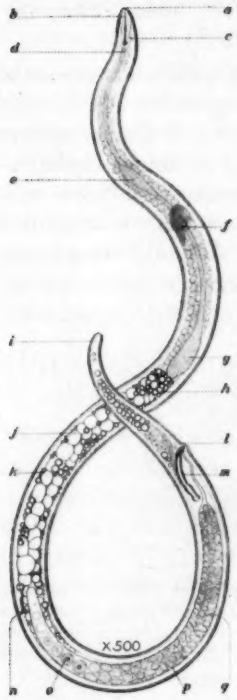

Fig. 2. Nearly adult male of *Tylenchulus semi-penetrans*. *a*, mouth pore; *b*, anterior part of spear; *c*, protruding-muscle of spear; *d*, beginning of oesophagus; *e*, deteriorated median bulb; *f*, nerve-ring; *g*, deteriorated posterior bulb; *h*, beginning of intestine; *i*, terminus; *j*, larger intestinal granule; *k*, smaller intestinal granule; *l*, anus; *m*, left spiculum; *n*, excretory pore; *o*, spermatocyte; *p*, vas deferens; *q*, spermatozoon.

roots, and Circular No. 85 was issued to call the attention of other investigators to the subject.

The writer has recently examined the nematode mentioned, and finds it a new generic form, for which the name **Tylenchulus** is most appropriate.

Tylenchulus has the characters of **Tylenchus**, except that, (1) there is no functional anus; (2) the excretory pore is near the middle of the body, or even farther back in the adult female; (3) there is no male bursa; (4) the male practically loses the spear at the final moult; (5) the cuticle of the female is much thickened when the posterior portion of the body becomes saccate at maturity; (6) the vulva is located in a deep suture.

The type species is:

Tylenchulus semi-penetrans, nov. gen., n. sp.

$$\frac{3.\ \ 16.\ \ 21.\ \ 67.^{1}\ \ '00.\ \ 94.^{2}}{2.2\ \ 7.1\ \ 8.7\ \ 20.\ \ 7.1\ \ 2.7}\ .5\text{ mm.}$$

$$\frac{3.3\ \ 16.\ \ 29.\ \ —M\ \ 88.}{2.2\ \ 2.7\ \ 2.7\ \ 3.\ \ 2.7}\ .4\text{ mm.}$$

Cuticle naked, traversed by 400–500 plain transverse striae. Neck cylindroid, becoming convex-conoid near the continuous head, which is rounded in front. No lips, amphids or eye-spots. Spear and oesophagus typically tylenchoid. Median bulb ellipsoidal, with valve; posterior swelling pyriform to elongated, without valve. Male tail conoid to the somewhat blunt terminus. Posterior part of the adult female saccate, with wide blunt tail bent toward the ventral side. Vulva in the midst of a prominent ventral suture.

Habitat: Parasitic on citrus roots in California and Florida.

Fuller publication with illustrations will follow.

[1] Measurement near the middle of the saccate part.

[2] Arbitrary, as there is no anus.

VITAL STATISTICS.—*A natural population norm.*[1] II. ALFRED J. LOTKA. Communicated by G. K. Burgess.

II. *Proportion of sexes.* In addition to the features discussed in part I of this paper, Table III also shows the calculated and observed ratio of the total number of females to that of males in the population. The calculated figure is obtained as follows: Let B_m be the total number of male birth per annum and N_m the total number of males in the population. Let B_f, N_f similarly refer to females. Then b_m, b_f, the male and female birthrates per head per annum, are defined respectively by

$$b_m = \frac{B_m}{N_m}, \quad b_f = \frac{B_f}{N_f} \tag{8}$$

Hence

$$\frac{N_f}{N_m} = \frac{B_f}{B_m} \cdot \frac{b_m}{b_f} \tag{9}$$

Now $\frac{B_f}{B_m}$, the proportion of female births to male births, is a characteristic constant of the population, and in the case under consideration its value was $\frac{1}{1.0382} = 0.9632$. For the values of b_m, b_f we have by (4) and Table I

$$\left.\begin{aligned} \frac{1}{b_m} &= 41.35 - 1312 r_m + \cdots \\ \frac{1}{b_f} &= 44.62 - 1467 r_f + \cdots \end{aligned}\right\} \tag{10}[2]$$

Hence (9) becomes

$$\frac{N_f}{N_m} = 0.9632 \left\{\frac{44.62 - 1467 r_f}{41.35 - 1312 r_m}\right\} \tag{11}$$

$$= 1.0395 \left\{\frac{1 - 32.878 r_f}{1 - 31.729 r_m}\right\} \tag{12}$$

[1] See this Journal **3**: 241–248. 1913.

[2] The convergence of the series (10) is such that in the computation of b and of c (a) seven terms had to be retained; but the quotient (12) is much more rapidly convergent, so that only two terms are here required.

In the numerical case here considered $r_m = 0.01431$,
$r_f = 0.01373$.

This gives, for the ratio $\frac{N_f}{N_m}$ the computed value 1.045, as against the observed value 1.054.

III. *Age-distribution at death.* (3) we have for the total number of deaths between the age-limits 0 and ∞

$$D = -Nb\int_0^\infty e^{-ra}\dot{p}(a)\,da \tag{13}$$

Similarly, between the age-limits a and $(a + da)$

$$\frac{dD}{da}da = -\frac{b}{d}e^{-ra}\dot{p}(a)\,da \tag{14}$$

Introducing a coefficient of age-distribution at death, defined in a manner analogous to that applied to the living population, but denoted by $c'(a)$, this gives

$$c'(a) = -\frac{b}{d}e^{-ra}\dot{p}(a) \tag{15}$$

To find the proportion of deaths between the ages a_1 and a_2 we integrate

$$\int_{a_1}^{a_2} c'(a)\,da = -\frac{b}{d}\int_{a_1}^{a_2} e^{-ra}\dot{p}(a)\,da \tag{16}$$

$$= -\frac{b}{d}\left[e^{-ra}p(a)\right]_{a_1}^{a_2} + \frac{r}{b}\int_{a_1}^{a_2} c(a)\,da \tag{17}$$

The last integral has already been computed in determining the age-distribution in life, so that we can now readily calculate the age-distribution at death. As a matter of fact, in the process of computing the age-distribution in life many of the data required for computing $\left[e^{-ra}p(a)\right]_{a_1}^{a_2}$ by series are obtained, so that the work is largely disposed of. The computation was carried out for males only. The results obtained are shown in Table V and figure 5. Here again the agreement between the observed and calculated values is very close.

TABLE V

AGE-DISTRIBUTION AT DEATH (MALES)

	CALCULATED	OBSERVED
0– 5	429	419
5–10	37	36
10–15	18	18
15–20	21	23
20–25	28	28
25–35	62	59
35–45	69	68
45–55	79	75
55–65	88	88
65–75	93	97
75–∞	75	89
	999	1000

IV. *Average age at death.* The average age at death is given by

$$A_D = \int_0^\infty a\, c'(a)\, da \tag{18}$$

In the case of the stable age distribution this becomes (see 15)

$$A_D = -\frac{b}{d}\int_0^\infty a\, e^{-ra}\, \dot{p}(a)\, da \tag{19}$$

$$= -\frac{b}{d}\Big[a e^{-ra}\, p(a)\Big]_0^\infty + \frac{b}{d}\int_0^\infty (1 - ra)\, e^{-ra}\, p(a)\, da \tag{20}$$

$$= 0 + \frac{1}{d}\int_0^\infty c(a)\, da - \frac{r}{d}\int_0^\infty a\, c(a)\, da \tag{21}$$

$$= \frac{1}{d} - rA_L, \tag{22}$$

if we denote by A_L the mean age of the living population.

In a stationary population we have $r = 0$, $d = d_0$ and hence $A_D = \dfrac{1}{d_0} = l$, where l is the mean length of life, viz., $l = \int_0^\infty p(a)\, da$.

V. *Third equation between b, d and r.* We have so far considered b, d and r as connected by two relations, namely equation (2) (or

its equivalent 3), and the defining equation $r = (b - d)$. In actual fact of course b, d and r are in every instance completely determined. There must therefore be a third relation between

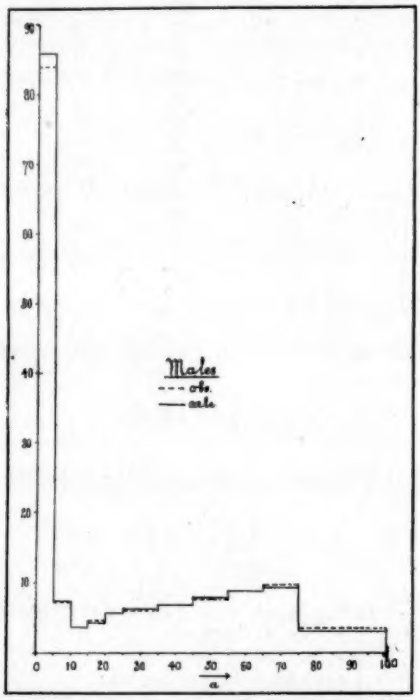

Fig. 5. Age-distribution at death, England and Wales 1871–1880.

them. In fact if one male, at age a, gives rise, on an average, to $\beta_m(a)$ male births per unit of time, we must have

$$B_m = N_m \int_0^\infty c_m(a)\,\beta_m(a)\,da \tag{25}$$

$$b_m = \int_0^\infty c_m(a)\,\beta_m(a)\,da \tag{26}$$

For the stable age-distribution this becomes by (1)

$$b_m = b_m \int_0^\infty e^{-ra}\, p_m(a)\, \beta_m(a)\, da \tag{27}$$

$$1 = \int_0^\infty e^{-ra}\, p_m(a)\, \beta_m(a)\, da \tag{28}$$

an equation which determines r.

Equation (28) gives rise to two reflections.

In the first place it can be seen by inspection, that $r \gtreqless 0$ according as $\int_0^\infty p_m(a)\, \beta_m(a)\, da \gtreqless 1$. This is due to the fact that this last integral represents the ratio of the total male births in two successive generations.

The second conclusion which we may draw from equation (28) is at first sight somewhat surprising. In that equation we may, without altering its meaning in any way, write the limits of the integral a_1 and a_2, instead of 0 and ∞, if we denote by a_1 and a_2 the lower and upper limits of the reproductive period. For outside these age limits the function $\beta(a)$ has everywhere the value 0, so that the terms of the original integral outside these limits contribute nothing to the numerical value of the integral. This being so, the per cent rate of increase of a population in which the stable age-distribution has become established is quite independent of any factors which may affect the life of individuals outside the reproductive age limits—so long as conditions within these limits remain unchanged. Thus, if we were dealing with a herd of cattle, for instance, it is quite immaterial, so far as the effect upon r is concerned, how we slaughter the cattle of the herd, so long as we spare the individuals of breeding age. This is a somewhat surprising result, especially as it applies not only to the superannuated, but also to the young, immature cattle.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

BOTANY.—*The catalpa septum: a factor in distinguishing hardy catalpa.* WILLIAM H. LAMB, Forest Service. Proceedings of the Society of American Foresters, **7**: No. 1. 1912.

This is a discussion of the distinguishing characteristics of hardy catalpa (*Catalpa speciosa*), and common catalpa (*Catalpa catalpa*), with emphasis upon the septum as a distinguishing feature. The septum is the long wrinkled partition within the pod, along which the seeds are arranged. The septum of hardy catalpa is greatly thickened along the middle, giving it a rounded appearance in general outline. The septum of common catalpa, on the other hand, is only slightly thickened along the middle and appears relatively flat. This variation in shape furnishes us with a valuable means for recognizing hardy catalpa. Diagramatic drawings of enlarged sections of typical septa have been made to illustrate this important distinction. W. H. L.

ZOOLOGY.—*Crinoidea* (supplement). AUSTIN HOBART CLARK. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905, Bd. **4**: Lief. 6: S. 307–315, Taf. 4. 1913.

Since the publication of the author's memoir on the crinoids of west Australia (this series, **3**, part 13, pp. 435-467) additional specimens collected by the Hamburg Southwest Australian Expedition have come to light. An account of these, including the description of a new genus (*Petasometra*) and species (*P. helianthoides*), is here given. In an appendix is a list of annotations by which the information included in the original memoir, written three years ago, is brought up to date.

A. H. C.

ICHTHYOLOGY.—*The sense of smell in fishes.* G. H. PARKER and R. E. SHELDON. Bulletin of the Bureau of Fisheries, **32**:33–46. 1912. Issued May 3, 1913.

The common belief that fishes have a sense of smell has been hitherto without the support of physiological evidence. In this paper are recorded the results of experiments with three common species of fishes which show reactions undoubtedly dependent upon the olfactory apparatus.

1. A current of water passes thru the nasal chambers of many fishes in a direction from anterior to posterior. It may be produced by ciliary action (*Ameiurus*), by pressure due to the action of the respiratory muscles (*Fundulus*), or it may be a part of the true respiratory current (*Mustelus*).

2. By means of this current dissolved substances in the water are brought into contact with the olfactory surfaces.

3. Fishes distinguish packets containing hidden food from similar packets without food.

4. This power of distinguishing the two classes of packets is lost when the olfactory tracts are cut, when the anterior olfactory apertures are stitched up or when the apertures are plugged with cotton wool. It is revived on reopening the apertures by taking out the stiches or removing the cotton wool.

5. *Mustelus* and *Ameiurus* discover their food chiefly thru the olfactory sense; *Fundulus* uses the eyes in addition to the olfactory organs for this purpose.

6. *Mustelus*, *Fundulus*, and *Ameiurus* use the olfactory organs to scent food much as land animals do; these organs are true organs of smell, i.e., distance receptors for the chemical sense. G. H. P. and R. E. S.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 718th meeting was held on January 18, 1913, at the Cosmos Club, President ABBOT in the chair; about 35 persons present. The minutes of the 716th meeting were read and approved.

Mr. M. D. HERSEY presented a paper on *A mechanical model of the least square adjustment.* The apparatus exhibited consisted of a sheet of coördinate paper mounted on a board for the plotting of points, a light aluminum rod, and a supply of rubber elastics and push pins. The values under discussion were plotted by the push pins, allowance being made for the unstretched lengths of the elastics by which the bar was suspended. The model was used to show the mechanical adjustment of the tests of a mercury barometer; the results were compared with those by the usual solution of normal equations. The speaker discussed methods for weighting different observations, the determination of the probable error by the model, and the application of the principle for solution of case involving several unknowns. The paper was discussed by Messrs. WHITE, RINES, and ABBOT.

Mr. H. C. DICKINSON presented a paper by himself and Mr. E. F. MUELLER on *New calorimetric resistance thermometers*, describing and exhibiting the improved type of sensitive resistance thermometer developed at the Bureau of Standards. A coil of 0.1 mm. platinum wire is wound on a thin mica strip and enclosed with mica insulation in a platinum (or silver) sheath pressing firmly on the flat coil. The upper end of the sheath is fused or soldered to a glass tube carrying the leads. The instrument may be used from $-180°$ to $500°$. The constancy of this type is shown by the fact that for the best of them the resistance at $0°$ has not changed more than 3 or 4 parts per million in three years, an amount that may be due to impurities in ice used, errors in resistance standards, or changes in the leads. Thermometers of this type are now being manufactured commercially. Mr. MARVIN discussed certain details of their construction.

Mr. H. L. CURTIS spoke on *Some properties of electric condensers.* A perfect condenser should maintain a constant capacity independent of outside conditions, should have an infinite insulation resistance and no absorption. The problems of construction are mechanical and electrical; the first being to keep the plates so they will have the same area and be the same distance apart, and the second being the insulation resistance and the anomalies of the dielectric. The speaker discussed these problems for the air or gas, mica, paper, and glass condensers.

For the gas dielectric the greater problem is the mechanical one, while for the solid dielectric the question of anomalies is the more serious. The paper was discussed by Mr. GRAY with reference to values of capacity at different voltages.

The Secretary read communications inviting members of the Society to attend the meeting of the Washington Academy of Sciences on January 30 at the Cosmos Club to hear an illustrated address, *Some observations of the volcano Kilauea in action*, by Dr. A. L. DAY; and also to attend a meeting on January 27, at the Bureau of Standards to hear Professor MAGIE of Princeton on *Our conception of energy*.

The 719th meeting was held on February 1, 1913, at the Cosmos Club, with President ABBOT in the chair and 16 persons present. The minutes of the 718th meeting were read and approved.

By invitation Mr. ALFRED LOTKA presented an illustrated paper on *A natural population norm*. Published in full in this JOURNAL, **3**: 241, 289. 1913. The paper was discussed by Messrs. BURGESS, WOLFF, BURROWS, and ABBOT.

Under informal communications Mr. ABBOT spoke of the recent work conducted and the results obtained with the pyrheliometer showing that a standard scale of pyrheliometry is now well established. Mr. HUMPHREYS offered an explanation of the present mild winter in the District of Columbia and neighboring region in that the high pressure center usually located in the East Atlantic off Gibraltar has shifted of late to the neighborhood of the Bermudas and in consequence we receive with southerly winds the mild marine climate. No cause for the shift could be assigned. Mr. KIMBALL spoke of the remarkable diminution since June 10, 1912, of the Solar radiation as measured at the surface of the Earth; during the six months to December the radiation was but 83 per cent of what it had been in previous years at Mt. Weather. There appears to be some relation with the eruption of the Volcano Katmai in Alaska of June 6, 1912. A study of the results promises to give interesting light on the circulation of the atmosphere.

The 720th meeting was held on February 15, 1913, at the Cosmos Club. President ABBOT in the chair; 50 persons present.

The evening was devoted to the address of the retiring President, Mr. E. B. ROSA, on *The function of research in the regulation of natural monopolies*. Published in full in this JOURNAL, **3**: 201. 1913.

The 721st meeting was held on March 1, 1913 at the Cosmos Club. This meeting was held conjointly with the Washington Academy of Sciences. President TITTMANN, of the Academy, presided. There were about 200 persons present.

The Right Honorable JAMES BRYCE, O.M., British Ambassador to the United States, gave an address on *The physical aspects of Australia and New Zealand*. The islands of New Zealand are very mountainous and the scenery of great beauty. The climate is generally moist. A

large part of the country is suitable for cultivation but because of the distance from market the raising of cattle and sheep is the industry most developed. The vegetation is remarkable, particularly the tree ferns, which grow to great size. The native Maori people are much like the Hawaiians in character and language and are of a very high order of intelligence. Australia is quite unlike New Zealand in its physical features. The interior is a great plain and is generally quite arid as the outside fringe of mountains on all sides prevents the rains from reaching it. The presence of copious deep level water makes possible the use of artesian wells and much of the interior may be developed by irrigation. The interesting question as to the source of this deep level water was discussed briefly. The flora and fauna are peculiar. The aborigines are entirely unlike those of New Zealand, being of negroid type and of a very low state of culture. The address was illustrated by wall maps and lantern slides.

To express the appreciation of the meeting for the delightful and instructive address, the President called for a rising vote, which was unanimous.

The 722d meeting was held on March 15, 1913, at the Cosmos Club. Vice-President FISCHER in the chair; 27 persons present. The minutes of the 719, 720, and 721st meetings were read and approved.

Because of illness, Mr. G. W. SPENCER, who was to have presented a paper *Relationship between terrestrial gravity and observed Earth movements of eastern America*, was unable to address the meeting.

Mr. I. G. PRIEST read a paper on *A photometric error sometimes accompanying the use of a pair of nicols, and a proposal for its elimination*, illustrated with lantern slides. In extensive optical trains such as occur in spectrophotometers and colorimeters the use of a pair of nicols following the simple theory may be impaired by oblique reflections of the plane polarized beam whose plane of polarization is rotated with the rotating nicol. An example was cited and illustrated by lantern slides and formula given showing variation of intensity of beam from proportionality to the square of the sine of the angle θ thru which analyzing nicol is rotated from the position of "crossed nicols." A triplet of nicols in train instead of a pair is proposed with end nicols fixed and middle one rotating, in which case, with principal planes of end nicols parallel, the intensity is proportional to $\sin^4\theta$, and if perpendicular, to $\sin^2\theta\cos^2\theta$. Trouble may be more simply eliminated by using only a pair of nicols but rotating the polarizer instead of the analyzer, provided the beam incident on polarizer is entirely unpolarized. The paper was discussed by Messrs. COBLENTZ and TILLYER.

Under informal communications Mr. W. BOWIE presented a paper on *The precise level net of the United States*, giving the results of the recent adjustment by the Coast and Geodetic Survey of the different circuits of the precise leveling net of the United States. 44,720 kilometers of leveling have been run in two directions and about 10,700 permanent bench marks have been placed in all but seven states. The values

resulting from the adjustment will probably be held as standard elevations for an indefinite time and be of great benefit to surveyors and engineers. New circuits will be fitted to the old levelings as, while they would theoretically give new and better values, the changes would be small as regards practical use. The paper was discussed by Messrs. C. A. BRIGGS, RINES, WRIGHT, HUMPHREYS, and SOSMAN.

Mr. W. J. HUMPHREYS presented an illustrated paper on *Factors in climatic changes in the past.* The suggestion that the important factor has been the presence of veils of volcanic dust in the atmosphere was made in a revised form. Considerations of the material, density, and size of particles of volcanic dust show that interference with ingoing radiation would be five or more times that on outgoing radiation, which would mean lower temperature. Calculations show that one-tenth cubic mile of dust would account for a glacial period.

The 723d meeting was held on March 29, 1913, at the Cosmos Club. President ABBOT in the chair; about 40 persons present. The minutes of the 722d meeting were read and approved.

Mr. L. W. AUSTIN presented a paper on *Recent experiments in radiotelegraphy.* Owing to non-receipt of data from S.S. *Salem* giving results of tests between the Arlington station and the *Salem* while en route to and from Gibraltar the speaker could not report on this work as he had expected. The results of the United States Navy experiments of 1909–10 were reviewed and formulae discussed. The high power station at Arlington was briefly described. In it are incorporated the suggestions and ideas developed in the 1909–10 work. It differs from most high power stations in that it has a three tower arrangement for antennae instead of the more usual umbrella type; one tower is 600 feet and the other two each 450 feet high. Ground resistance has been practically eliminated by grounding with copper net—this was found to be essential and makes no difference in the radiant energy. The seasonal variation of received signals was discussed—the energy received dropping during the summer. Difference in ease of transmission during day and night was pointed out; day conditions are generally more constant while at night there are great fluctuations. Discussed by Mr. BAUER as to greater ease of transmission along magnetic meridians; by Mr. ABBOT as to magnitude of difference between day and night conditions; by Messrs. WHITE, HUMPHREYS, and WOLFF as to the calculations at Arlington.

Mr. F. A. KOLSTER spoke on *National and international regulation of radiocommunication.* The uses and chief purposes of radiocommunication are protection to life at sea, aid to navigation, communication between ship and ship and shore, and naval and military operations. The first regulation conference held in 1906 in Berlin was due largely to attempts made to monopolize the business and the great amount of interference due to amateurs. At the second conference held in 1912, in London the discussion was practically confined to matters relating to operation of apparatus. Interference can be best avoided by restricting use of waves of definite lengths for definite purposes, e.g., wave lengths between 600 and

1600 meters are used only for naval and military purposes. In most foreign countries amateurs are not allowed to operate; in the United States they may do so but are restricted to the use of wave less than 200 meters in length. The speaker read and discussed at length some of the regulations. The next International Conference will be held in Washington in 1917. Paper was discussed by Mr. BOWIE as to importance of radiotelegraphy in the determination of longitude on islands and in unexplored regions; also by Messrs. BAUER, RINES and ABBOT. Mr. BAUER told of the receipt at Salah, through the courtesy of a French officer, of time signals by the magnetic party crossing the Sahara, the signals being received directly from Paris, 1600 miles distant.

J. A. FLEMING, *Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 267th meeting was held on March 12, 1913, at the Cosmos Club.

The following informal communications were presented: *An overthrust fault in miniature from Montana:* G. S. ROGERS; *Some new occurrences of alunite:* F. C. SCHRADER.

REGULAR PROGRAM

Geology of a portion of Northwest Alaska (Illustrated): PHILIP S. SMITH; *A Pleistocene cave in Devonian limestone near Cumberland, Maryland:* J. W. GIDLEY.

The work of the Alaska Railroad Commission: ALFRED H. BROOKS. In accordance with an act of Congress, approved August 24, 1912, President Taft appointed on August 31 the Alaska Railroad Commission as follows: Major J. J. Morrow, U. S. Army, Chairman; Alfred H. Brooks, U. S. Geological Survey, Vice-Chairman; Lieut.-Commander Leonard M. Cox, U. S. Navy; Collin M. Ingersoll, Consulting railway engineer, New York City.

The Commission sailed from Seattle, September 10, and spent some two and a half months in field investigations. The work included an examination of all the harbors on the Pacific seaboard of Alaska which have been suggested as coastal terminals, also all the existing railways of central Alaska. The journey was extended to the lower Susitna Valley, and later to Fairbanks by the winter trail which follows closely one of the proposed railway routes into the Yukon basin.

The Commission began its office work on December 2. This included a careful analysis of all the engineering data available regarding Alaska railway routes, aggregating some 3000 miles in length. On the basis of this information estimates of construction and operating costs were made for some sixteen different lines. A fairly comprehensive study was also made of the data relating to the resources of central Alaska, including minerals, agriculture, forests, and water power. The work of the Commission included a consideration of the existing transportation conditions in Alaska, together with statistics on commerce. Climate

and distribution of population were also among the subjects investigated. The report was submitted to the President on January 20, 1913, and has since been published under the title, *Railway Routes in Alaska:* Document No. 1346 H. R. 62d Cong., 2d Session, 172 pp., 1913. The maps and profiles were submitted on March 1, 1913. These are now in print as Part II of the report.

RALPH W. RICHARDS, *Secretary.*

The 268th meeting was held on March 26, 1913, at the Cosmos Club. At the session of the council preceding the open meeting the following members were elected delegates to represent the Society at the meeting of the International Geological Congress at Toronto, August 7 to 12, 1913:—F. L. RANSOME, DAVID WHITE, J. S. DILLER, E. O. ULRICH.

The following informal communications were presented: *A discovery of gypsum and anhydrite in a drill hole at Centerville, Iowa:* F. C. GREENE.

Niter near Melrose, Montana: RALPH W. RICHARDS. Niter is found as thin crusts on the surface of black limestone presumably of Devonian age on Camp Creek about 3½ miles northeast of Melrose; it is also disseminated in veinlets to a less extent thru the rock. The purest salt occurs as a snowy white to slightly yellow mass of needle-like crystals, in the loose rock talus at the base of ledges. About 86 per cent of the mass is soluble in water; the soluble portion has been analyzed by R. H. Bailey and the following results obtained.

Calcium sulfate	13.94
Sodium sulfate	3.30
Sodium chloride	20.42
Sodium nitrate	21.77
Potassium nitrate	39.48

The nitrates make up about 61.25 per cent of the total water soluble portion. An attempt was also made to determine the niter present in the limestones; the water soluble portion was found to range from 1 to 5 per cent.

REGULAR PROGRAM

Quaternary problems of central Alaska: HENRY M. EAKIN. The present drainage of Alaska is evidently superimposed upon an older topography whose drainage had little resemblance in arrangement to that of today. This is shown by the topographic irregularities of the valleys of the present master streams that were developed, in part at least, in Quaternary time; in the irregular distribution of alluvial plains that represent old erosional depressions; and in old valleys that are now traversed by inadequate streams or are entirely abandoned. The assumption of crustal movements to account for these features is precluded by the irregularities of the lowland basins; by the flood plains of tributaries in reaches where the trunk stream has no flood plain, and in the wide accordance in elevation of high terraces and silt deposits.

The hypothesis advanced involves the ponding of water in the old

drainage basins by glacial obstruction: the establishment of drainage lines across the lowest available divides; and the topographic adjustment of the present river systems. The maximum known extent of ice in late geologic time is inadequate to the requirements of this hypothesis, but data bearing on this point are incomplete.

Igneous rocks of the Raton Mesa Region: J. B. MERTIE, JR. The mesas near Raton, New Mexico, have resulted from the differential effect of erosion upon a series of lava flows and the surrounding sedimentary rocks. The vulcanism began in post-Eocene time and continued intermittently to recent time. The oldest flows cap the highest mesas, thus preserving the original land surface over which they spread; while the latest flows lie in the present lowlands. Four series of flows have been recognized on the basis of erosional unconformities which separate them. The first or oldest series is composed of numerous fissure flows of great thickness and originally of great extent. They are uniformly olivine basalts. The second series is not materially different from the first. The third series contains a variety of rock types, among which hornblende hyalorhyolite, ægerite trachyte, augite andesite, hauyne basalt, basanite, quartz basalt, and normal olivine basalt have been recognized. Many of these flows came from central vents, and most of the resulting rock types show greater or less amounts of glass. The flows of the fourth series have come in every instance from volcanic cones of the central type and are uniformly glassy in character. They are, so far as observed, normal olivine basalts. The dyke rocks of the area include kersantites, vogesites, camptonites, limburgites, and nephelinites.

The results of the investigation show a gradual change from the fissure to the central type of eruption, an increasing viscosity in the lavas accompanied by explosive volcanic action, and the development of numerous extreme rock types, or magmatic end products. All these phenomena are interpreted as the results of dying volcanic activity.

Remarks on the geology of the Bahama Islands, and on the formation of the Floridian and Bahaman oolites: THOMAS WAYLAND VAUGHAN. The author gave a brief résumé of some studies he has conducted during the past seven years under the joint auspices of the United States Geological Survey and the Department of Marine Biology of the Carnegie Institution of Washington. The remarks on the geology of the Bahamas were based on observations made and material collected by him as a member of an expedition conducted by Dr. A. G. Mayer of the latter organization, during last April and May.

The submarine and subaerial topographic features of the Bahamas were described briefly. The general country rock, across the Great Bahama Bank from Gun Cay to Northwest Passage and that of New Province and Andros islands, is oolite similar to the oolite of Florida. Along the windward faces of the islands ridges of wind-blown material, rising above the lower platforms are usual.

The studies of Dall, Sanford, and the author, in association with Geo. C. Matson, led to the opinion that the finely divided calcium car-

bonate oozes so abundant in Florida waters are chemical precipitates. Drew showed in 1911 that denitrifying bacteria are an important agent in effecting this precipitation in Florida waters; and in 1912 he extended his researches to the Bahamas, where he found them enormously abundant and active, as many as 160,000,000 being found in 1 cc. of surface mud on the west side of Andros Island. Rainey in 1858, Harting in 1871, and Linck in 1903 (and perhaps others), showed that calcium carbonate precipitated by an alkali forms spherulites; and Drew noted a similar tendency of the calcium carbonate precipitated on his cultures. Murray and Irvine showed that at higher temperature chemically precipitated calcium carbonate is of the aragonite form.

Bahaman shoal water bottom muds were collected at many stations, especially through South Bight and off its west end. The muds when collected were not observed to contain oolite grains, altho these may have been present and may have escaped notice, but all the muds when examined at the end of November did contain such grains, which ranged from spherulites 0.004 or 0.006 mm. in diameter, to grains of ordinary size, 0.10 to 0.80 mm. in diameter. The muds are composed of a mixture of aragonite and calcite. In order to test the growth of the grains, samples of a number of muds were strained through No. 10 bolting cloth, which has a mesh of about 0.13 mm. in size, and the fine material was put into bottles containing sea-water. During the first half of March a portion of each sample was studied. The formation of oolite grains was found to be in progress in every sample, and numerous grains were so large as manifestly to preclude their having passed thru the mesh of the bolting cloth. The experiments demonstrated both the increase in the number of spherulites and the increase in the size of the grains. The precipitated calcium carbonate may segregate around a variety of nuclei, for instance, spherulites formed of precipitated calcium carbonate, small grains of sand, shells of foraminifera, and gas-bubbles.

Altho there is need for additional study of the factors that accelerate, retard, or inhibit the formation of spherulites and the growth of the grains, the empirical facts in the process of the formation of the Floridian and Bahaman oolites are demonstrated. They are as follows: (1) Denitrifying bacteria are very active in the shoal waters of both regions and are precipitating enormous quantities of calcium carbonate which is largely aragonite; (2) this chemically precipitated calcium carbonate may form spherulites which by accretion may become oolite grains of the usual size, or it may accumulate around a variety of nuclei to build such grains.

Two important deductions may be made from the knowledge of this process, viz.: (1) Neither the Bahamas nor the oolitic keys of southern Florida are coral islands, but they have been formed by this other process. Elevated coral rock is exceedingly scarce in the Bahamas and the recent reef of Andros is comparatively insignificant as a constructional geologic agent. The material composing the land masses and much of the submarine platforms of the Bahamas are thus removed

from the category of "coral rock" and the living reef reduced to a subordinate ratio as a builder of limestone. (2) Drew's unfortunately incompleted studies of the distribution of denitrifying bacteria have shown them to be most prevalent in the shoal-waters of the tropics. They therefore conform to the principles enunciated by Murray for the distribution of lime secreting organisms. By combining the results of Drew and Murray, the deduction seems warranted that great limestone formations, whether they be composed of organic or of chemically precipitated calcium carbonate, were laid down in waters of which at least the surface temperatures were warm, if not actually tropical.

FRANK L. HESS, *Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 466th regular meeting of the Anthropological Society of Washington was held in the National Museum February 18, 1913, the President, George R. Stetson in the chair.

Professor W. H. HOLMES read a paper on: *Agricultural implements of the mound-builders.* The rich alluvial prairie of the middle Mississippi valley is especially suited to the practice of agriculture, and here are found large numbers of skillfully made flint blades of large size adapted to hafting as hoes and showing unmistakable evidence of long usage in operations that gave the edge a high degree of polish. They are made of grayish flint or chert, which occurs in the form of flattish nodules especially in southern Illinois. These nodules were readily shaped by fracture with stone hammers, and vast numbers were worked up by the mound-building tribes. The processes of manufacture were demonstrated by the speaker and it was shown with what ease and rapidity the blades could be made.

It was also shown by examples obtained from the Missouri river tribes that hoes made of scapulae of the buffalo were in use in very recent times and that the hoes found by excavation in ancient sites near Omaha correspond to these recent Indian forms in shape, manner of hafting, and surface polish, and that both display, altho in bone, precisely the same kind of polish and markings as the similarly shaped hoes of flint. It was suggested that these flint hoes were modeled after scapular hoes, since these were in general used by the tribes and have doubtless been in use from very early times among all the tribes advanced to the sedentary agricultural stage of culture.

With regard to questions of the antiquity of the stone and bone hoes which have recently been raised, it was suggested that since the buffalo was a comparatively recent arrival in the Mississippi valley, a culture in which the bones of buffalo are represented must be younger, not older, than that of the mound-builders, since no traces or representations of the buffalo are found within the older Indian mounds.

This paper was briefly discussed, Mr. Stetson read some notes concerning stone articles recently found in Britain, and Professor Holmes commented thereon and then read a paper on the *Scope and relationship*

of history and archaeology, in abstract as follows: The term history as applied to the human race is a comprehensive designation corresponding to Anthropology which is defined as the science of man. According to Powell's classification Anthropology may be considered under seven heads giving rise to as many branches of research, as follows: Somatology psychology, philology, sociology, sophiology, technology, and esthetology.

The records or sources of information to be drawn upon in these researches are comprised under two principal heads: Intentional or purposeful records, and non-intentional or fortuitous records.

The intentional records are of five forms (1) The pictorial—pictographs; (2) the commemorative—monumental structures; (3) oral—tradition and lore; (4) objective-mnemonic—quipu, wampum; (5) inscribed, written—glyphic, alphabetic. Fortuitous records take numerous forms: (1) The diversified material results of human activities in which the commemorative-mnemonic motives are absent but which comprise the great body of the products of handicraft; (2) the immaterial results of human activity as embodied in language, beliefs, customs, music, philosophy, etc.; (3) the ever existing unpremeditated body of memories which accrue to each generation and are in part transmitted adventitiously; (4) the record embodied in the physical constitution of man which when properly read, tells the story of his development from lower forms; (5) the records of intellectual growth and powers to be sought and studied in the constitution of the mind; (6) the environments which may be made to reveal the story of the nurture and upbuilding of the race throughout the past.

It is from these diversified records that the story of the seven grand divisions of the history of man must be drawn. Archeology stands apart from this classification of the science, traversing in its own way the entire field of research. It claims for its own more especially that which is old or ancient in this vast body of data. It is even called upon to pick up the lost lines of the earlier written records as with the shadowy beginnings of glyphic and phonetic writing and restore them to the historian. It must follow back the obscure trails of tradition and substantiate or discredit the lore of the fathers. It must interpret the pictorial records inscribed by the ancients on rock faces and cavern walls. Archeology is thus the great retriever of history.

The services of archeologic science are equally potent in the field of the fortuitous records for it reads that which was never intended to be read. The products of human handicraft, present and past, which have automatically recorded the doings of the ages are made to tell the story of the struggles, the defeats, and the triumph of humanity. The fortuitous records embodied in the non-material products of man's activities of today, are made to cast a strong light on the history and significance of the material things of the past. Even the body of knowledge gathered from many sources, stored in the memory of the living, may be made to illumine the past; and the physical and psychical man are in themselves records and may be made to tell the story of their own becoming and to

explain the activities and the products of activity thruout the ages. All that archeology gathers from this wide field of research is contributed to the volume of written history. It is thus not only the retriever of that which was treasured and lost, but also the savior and conservator of vast resources of history of which no man had previously taken heed.

In the great work of assembling the scattered pages and completing the volume of the history of man, archeology may well claim first place among the contributing sciences.

This paper was discussed by Messrs Casonowicz, Carroll, Swanton, Stetson, Hewitt, and others.

The 467th regular meeting was held on March 18, 1913, at the National Museum, the President, Mr. STETSON, in the chair.

Dr. JOHN R. SWANTON read a paper on *The Creek confederacy*. After explaining the geographical and linguistic positions of the tribes of the Creek confederacy with the assistance of a map, Dr. SWANTON traced the evolution of the confederation from a small nucleus of tribes speaking the Muskogee language to a large association, comprising a number of Hitchiti speaking people, the Alabama, Koasati, some of the Apalachee and Yamasi part of the Natchez, the Yuchi, and, for a time, some of the Shawnee. He showed that this association was facilitated thru the institution of a dual division of towns into white or peace towns and red or war towns, the towns of each division, or "fire," considering each other friends or allies and having opposing but not warlike relations with the towns of the other "fire." It thus happened that when an outside town or tribe came to be accepted as a "friend" of one of the white or red towns in the confederacy its position with reference to all of the other white and red towns was thus established and it entered into the confederate scheme. The communication of other common features to the new towns also took place, altho more slowly. Such features were the "green corn dance" or busk, or perhaps rather the Muskogee form of it, participation in common altho irregular councils, and the adoption of Muskogee as the standard language of intercommunication. The actual discontinuance of the proper languages of the various members of the confederacy was, fortunately for the ethnologist, much slower, several of them having persisted down to the present day. Thru the progressive adoption of smaller tribes and the practical destruction of some in warfare, a process accelerated by white contact, the Creek confederacy came to be almost the sole representative of eastern Muskhogean culture, and even influenced the culture of the Chickasaw to a marked degree. The great Choctaw body, on the other hand, maintained its cultural independence and was never dominated by the Creeks. In sharp contrast to the Creeks, whose national structure was built up by fitting numerous distantly related tribes into an artificial fraternal scheme, the Choctaw seem to have owed their sense of unity to an actual homogeneity in the Choctaw population, the occupancy of a common area, and the necessity to resist common enemies. They preserved perhaps the simplicity of culture existing among all Muskhogean Indians in

times long anterior to the formation of more complicated associations or confederacies.

A special meeting of the Anthropological Society of Washington was held March 25, 1913 in the National Museum, the President, Mr. Stetson in the chair. Professor GEORGE GRAVES MACCURDY read a paper on *Ancient man, his environment and his art.* This paper dealt with the environmental factor in human development. The newly discovered human remains from Piltdown, Sussex, and their significance. Recent finds in the terraces of the Somme Valley. The San Isidro Valley deposits near Madrid. Torralba, a large camp site in the Province of Soria, Spain, where a rude stone industry associated with an ancient fauna has been found. Caves of the Island of Jersey occupied by Mousterian man. Typical caves and rock shelters of southern France: La Quina, La Ferrassia, Placard. The art of the cave man in Spain and France: Altamira, Castillo, La Pasiega, Covalanas, Pindal, Font-de-Gaume, Cap Blanc, Niaux, Gargas, Laussel, Alpera, Cogul. Representations of the human form. La Combe, a cave in the Dordogne excavated last summer by Professor MacCurdy. Tuc d'Audoubert, a Pyrenean paleolithic cavern of great beauty discovered last July; its parietal art and unique figures of the Bison modeled in clay. Paleolithic art in its relation to magic; some of the causes which led to its development and eventually to its decay.

The paper is based largely on first hand observations made during the past summer. The lantern slides reproduce faithfully in color the remarkable paleolithic cavern frescoes. The epochs covered by the paper, beginning with the oldest, are: Eolithic or pre-Chellean, Chellean, Acheulian, Mousterian, Aurignacian, Solutrean, Magdalenian, and Azilian. These are all pre-Neolithic.

A special meeting of the Anthropological Society of Washington was held April 1, 1913, at the National Museum, the President, Mr. STETSON, in the chair.

Dr. J. H. GORE, who returned recently from a visit to the King of Siam, read a paper on *Siamese life and industries* illustrated by lantern slides. He described the Siamese basketry, matting, textile fabrics of silk and other material, also the bronze vessels, silver vessels, and excellent hammered silverware, the method of producing the latter being to fill a silver vessel with sand and hammer in the surface from the outside to form the ground, leaving the decorative human figures in series (beside other ornaments) in high relief. Usually the figures represent some mythological story. Dr. Gore's lantern pictures included farm-scenes, illustrations of games, festivities and elephant-capturing and views of the city of Bangkok, the aquatic human life of its rivers and canals, the palace, imperial crematories, and temples, including a beautiful rock cavern temple.

The chief resources of the country are the teak-wood forests and rice culture, most of the ships-decks of the world being supplied from the

former now managed by an expert forester, while the export of rice is great, about seventy rice mills of modern equipment being operated in Bangkok, besides a large amount of similar work which is done by more primitive methods and appliances throughout the country. The soil is exceedingly fertile in the main valley of the kingdom. There are about eighty miles of good roads around Bangkok and the streets of the city are well made, modern street-car lines running on some of them: but the remainder of the country is practically without roads.

The late king was notable for many enlightened reforms, such as freeing slaves, relinquishing the royal ownership in the land in the favor of those who had been long in occupancy and use of it, waiving the exemption of the royal lands from taxation and compiling and publishing an edition of the Buddhist scriptures, which he supplied to the libraries of the world.

The inhabitants of Cambodia are of stock similar to the Siamese, but are regarded by them as inferior. Their language is akin to the Sanscrit. The human images before their temples are not idols, but for ornament. There is a flame-like upward aspiring tendency in their decorative work. No magical or religious importance is attached to white elephants, so called, which are albinoes, white only in patches; they are regarded as curiosities and as such are given to the king.

The 468th regular and 34th annual meeting of the Anthropological Society of Washington was held on April 15th, 1913, at the National Museum, the President, Mr. STETSON, in the chair.

The minutes of the last preceding annual meeting were read and approved.

Obituary notices were presented as follows: Miss Alice Fletcher for Miss Sarah A. Scull; Mr. F. W. Hodge for Mr. W J McGee; Dr. Lamb for Dr. Robert Fletcher.

The following officers were elected and installed for the ensuing year: President, MR. GEORGE R. STETSON; Vice-President, Dr. JOHN E. SWANTON; Secretary, Dr. DANIEL FOLKMAR; Treasurer, Mr. J. N. B. HEWITT; Councillors: Mr. GEORGE C. MAYNARD, Mr. FELIX NEUMANN, Dr. I. M. CASANOWICZ, Dr. E. L. MORGAN and Mr. FRANCIS LA FLESCHE.

Invitations to meetings of the National Academy of Sciences and of the German Anthropological Association were presented and accepted with thanks.

WM. H. BABCOCK, *Secretary.*

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